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ROCKS and MINERALS

A Magazine for Mineralogist, Geologist and Collector . . .

. . . . . *Official Journal of The Rocks and Minerals Association*

MAY, 1938

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THE ROCKS AND MINERALS ASSOCIATION

PEEKSKILL, N. Y.

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Organized in 1928 for the increase and dissemination of mineralogic knowledge.

To stimulate public interest in geology and mineralogy and to endeavor to have courses in these subjects introduced in the curricula of the public school systems; to revive a general interest in minerals and mineral collecting; to instruct beginners as to how a collection can be made and cared for; to keep an accurate and permanent record of all mineral localities and minerals found there and to print same for distribution; to encourage the search for new minerals that have not yet been discovered; and to endeavor to secure the practical conservation of mineral localities and unusual rock formations.

Ever since its foundation in 1928, the Rocks and Minerals Association has done much to promote the interest in mineralogy. It has sponsored outings, expeditions, formations of mineralogical clubs and the printing of many articles that have been a distinct contribution to mineralogy.

Those of our readers who are members of the Association can rightly feel that they too were sponsors of these many achievements that have helped to give mineralogy a national recognition. Among your friends there must be many who would like to have a part in the Association's work—to share with you the personal satisfaction, the pleasure, and the benefits of membership. Will you give your friends this opportunity to join the Association by nominating them for membership? A nomination blank will be found elsewhere in this issue.

Each new member helps to extend the Association's activities—helps to make your magazine larger,better, and more interesting, and above all assists in the dissemination of mineralogical knowledge.

Some advantages of membership: All members in good standing receive:

(1) **Rocks and Minerals**, a monthly magazine. (2) A member's identification card that secures the privileges of many mines, quarries, clubs, societies, museums, libraries. (3) The right to participate in outings and meetings arranged by the Association. (4) The right to display a certificate of membership and to place after their names a designation indicating their membership or to advertise membership on stationary, etc. (5) The distinction and the endorsement which comes from membership in the world's largest mineralogical society.

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CONTENTS FOR MAY, 1938

PREHNITE 131

CHIPS FROM THE QUARRY (Editorial Page) 132

A MINERALOGICAL TRIP THROUGH THE MICHIGAN COPPER COUNTRY. By Kiril Spiroff 133

6th NATIONAL OUTING OF THE ROCKS AND MINERALS ASSOCIATION 144

ANCIENT MINE SAVED GREEK CIVILIZATION 147

GEM MINERALS OF THE REGION ABOUT OROFINO, IDAHO. By Boyd Olson 148

AN OCCURRENCE OF GRAPHIC TOURMALINE IN THE HUDSON HIGHLANDS. By S. B. Butler 149

FOSSILS AND FOSSIL COLLECTING. Part 3. By Irving G. Reimann.. 150

HOW OLD IS SOL? By Wm. Sulzer 151

BIBLIOGRAPHICAL NOTES 153

THE AMATEUR LAPIDARY 154

ASTERIATED ROSE QUARTZ 154

CLUB AND SOCIETY NOTES 154

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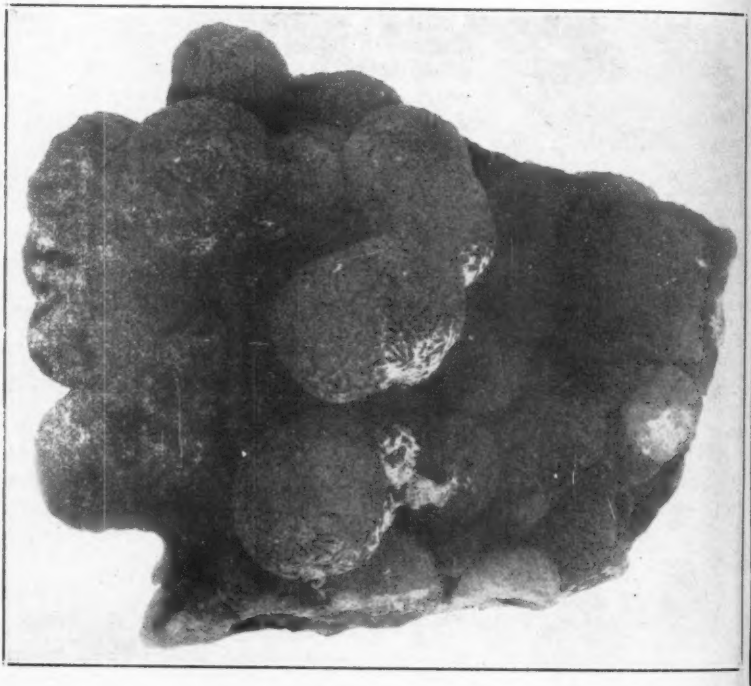

PREHNITE

New Street Quarry, Paterson, N. J.

PREHNITE

One of the loveliest of green minerals which always excites admiration is prehnite. It must not be assumed, however, that the mineral occurs in but the one color, green, as prehnite is also found in a gray, white, yellowish and even a bluish color.

Prehnite is an old mineral as it received its name in 1790, given it by Werner, after Col. Prehn who first found it at Cape of Good Hope in South Africa.

Prehnite is now a common mineral at many localities. Very fine barrel-shaped crystals have been found at St. Christophe near Bourg d'Oisans, in Dauphiné, France, associated with axinite, and accompanied by albite, calcite, epidote, orthoclase and sometimes incrusted by white asbestos.

In the United States an early locality for prehnite was near Farmington, about 10 miles west of Hartford, Conn., where it occurred finely crystallized, also botryoidal and mammillary. In the same state the mineral is now found in the Orenaug Hills basalt quarries near Woodbury, sometimes in good specimens but mostly of a yellowish-green color.

In Massachusetts, nice green botryoidal masses of prehnite with crystallized epidote occurs at the Lane's basalt quarries near Westfield, and make very charming specimens.

The mineral is also common in the copper region of Keweenaw Peninsula, Mich., where is occurs in veins with native copper. Quite often prehnite may include strings or grains of the copper and even silver. Prehnite also occurs in crystalline form, in geodes, and all varities vary from light green to oil-green in color.

The finest specimens of prehnite in America, if not in the world, occur in the traprock (basalt) quarries of New Jersey, particularly around Paterson. Here the mineral is found in many forms as botryoidal, nodular, incrusting, crystallized (often in individual crystals), pseudomorphous—all of which may present very fine and often spectacular specimens. Some of the Paterson prehnite have been cut into handsome gems.

In 1933, a large pocket was uncovered in the basalt wall of the lower New Street quarry, Paterson, which was 3 x 3 feet in area and over 35 feet in length, whose inside walls, roof and floor were lined with prehnite.

It is interesting to note that prehnite has not only been cut into beautiful gems but that it has also been given a number of names. Gilbert Hart, in his **Compilation of Gem Names,** which ran in series in ROCKS and MINERALS from Dec. 1927 to June 1931, records the gem varieties as follows:

Cape Chrysolite: green prehnite from South Africa.

Chlorastrolite: Impure prehnite from Lake Superior.

Edelite: prehnite from Aedelfors, Sweden.

Green Agate: zonochlorite variety of prehnite.

Green Star Stone: chlorastrolite.

Greenstone: zonochlorite or chlorastrolite.

Isle of Royale Greenstone: chlorastrolite.

Lake Superior Greenstone: chlorastrolite.

Turtle Back: chlorastrolite.

Zonochlorite: prehnite, banded, similar to or identical with chlorastrolite.

CHIPS FROM THE QUARRY

PETER ZODAC

Don't Be A Sloppy Collector

What is wrong with mineral collecting that it does not "take" with the general public? Do you know the answer? We do. The fault lies with the mineral collectors themselves. They are making no effort to cooperate with us in bringing this fascinating hobby before the eyes of their friends and acquaintances—on the contrary what efforts they may be making have the opposite effect.

For twelve years we have tried to bring mineralogy before the public by describing the beauty of minerals, their color, form, and interesting characteristics—always stressing the point that a collection of them was most desirable and worthwhile. We naturally had hopes that our readers would cooperate by carrying on the work within their own communities. We have even issued a special bulletin on "How to Collect Minerals", to encourage them. But what are the results? Very, very poor.

During the past few years we have visited a large number of collectors residing in states along the Atlantic coast and have examined about a thousand mineral collections. The collections in general—in the great majority of cases—were so poor that they were not even worth looking at. When we think of them we become greatly discouraged and in despair. No wonder mineral collecting is making no headway. No one can convince us that a lady or gentlemen on being shown some dirty "stones" in a filthy old box, or tucked away in a dilapidated old chest, or even thrown in the corner of a dark cellar, will be much impressed with minerals. Therefore very few mineral collectors, practically none at all, will ever be started in this way.

Then we have a class of collectors who are a little more fastidious. They will commandeer an unused china closet, a book case, or even have a cabinet built specially for their mineral treasures. But the "treasures"—oh! our head aches!—are very, very dirty specimens, sometimes dead leaves are attached to them while cavities often contain cocoons of moths or other undesirable things.

Of course these collectors always have specimens they want identified and a boxfull is soon brought for inspection. How we dread the ordeal of pawing through such specimens and especially when we are wearing good clothes. Our hands get dirty, the dust gets into our clothes and altogether it is a very disagreeable job. But if we did not do it then the collectors would feel offended.

We have tried, evidently in vain, to impress collectors with some of the simple fundamentals of mineral collecting. One of these is to have CLEAN specimens. When you bring home specimens collected at a mine, quarry, or other locality, WASH THEM in water with a brush (soap should be added in many cases) and after drying and labelling—place them in your cabinet. Then there will be no dirt or other impurity to mar the beauty of your specimens—nor to come off on the hands—and it will be a joy to handle them. And if visitors see such a collection, they will be impressed and may be induced to start a collection of their own.

Peter Zodac

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WHOLE NO. 82

A MINERALOGICAL TRIP THROUGH THE MICHIGAN COPPER COUNTRY

By KIRIL SPIROFF

Michigan College of Mining and Technology

The Michigan Copper Country is of unique character. It has the only large deposit of native copper in the world; the purity of the copper is such that it cannot be improved by metallurgical treatment; and the lodes are among the most persistent known in the world, for they continue down along the incline for a distance of 10,000 feet and horizontally for distances measured in miles. How much further they extend into the earth is unknown. The present limits of workings have been determined by mining and economic factors rather than by the continuity of the deposits.

The copper is found in porous parts of ancient lava flows and gravels. Copper from the lavas is called amygdaloidal copper, while that from the gravels is called conglomeratic copper. In both cases the copper is in a native form; that is, it is in a pure metallic state, uncombined with other elements. The only difference between the amygdaloidal and the conglomeratic copper is in the mode of occurrence. That is, the difference lies in the place where the copper was deposited.

Many eras ago lava flows were poured over the Lake Superior region. They are believed to have been of the quiescent type—quiet extrusions oozing out of fissures, spreading out over the surrounding terrain as horizontal sheets, and building up extensive gently sloping hills (plateaus). At various intervals the activity was more violent, and the ejected fragments were spread out as layers of gravel and sand over the surrounding lava flows. Then the district became a site of crustal disturbances. Forces created by earth upheaval pushed up the flat-lying lava flows and the intercalated gravels so that at the present ground surface they dip about 60° to the north, but flatten out somewhat at depth. Mineralization was accelerated; and copper-bearing solutions, percolating through the porous and fragmental tops of the lava flows and through gravels (conglomerates), fissures, faults and joints, deposited the native copper in favorable places. Many other minerals, not of economic value, are associated with the copper.

Native copper lured the man of the stone age; his crude implements have been found in shallow test pits and trenches near the sites of shafts that now reach over a mile in depth. The Indians living in this region when the white man arrived did no mining, and are said to have had no knowledge of the ancient workers. In 1841 a report by Dr. Douglass Houghton, the first state geologist of Michigan, aroused interest in the economic possibilities of the region. A monument to Dr. Houghton constructed from material from every geological formation found in the district, can be seen at Eagle River, Michigan, near the site where he was drowned.

At the present day, throughout areas

of great scenic beauty in the Keweenaw Peninsula there are many rock piles. These are accumulations from mining operations, and offer fascinating adventure for one interested in minerals. Over 60 minerals occurring in the Michigan Copper Country have been described, and at any rock pile at least 20 different minerals can readily be gathered. Minerals are abundant at every rock pile, but in some places certain minerals predominate or are of better quality than in others. These locations have been noted and are included in the itinerary in this paper, which describes the trip made by geology students of other regions who wish to study the Copper Country district. The trip begins at the south end of the range and goes north; it happens to start with the oldest exposed rocks and to work up in the series to the youngest. This route has many interesting geological features; in addition, it is very picturesque and has the advantage of good roads.

Often the embryo collector rapidly fills his packsack with specimens of different colors and appearance, only to learn that most of them are duplicates or are merely worthless trap rock. To avoid this waste and disappointment it is advantageous for collectors new to the district to visit the mineralogical museum at the Michigan College of Mining and Technology in Houghton. The museum is located on the fourth floor of the Engineering building and is always open to visitors. It contains one of the finest collections to be found in any educational institution in the United States. The principal collection of minerals is arranged according to Dana's "System of Mineralogy". In addition, there are special cases containing only Copper Country minerals. Here one may study specimens of the minerals which he wishes to collect.

Having become familiar with the minerals, and having equipped ourselves with geological pick, hand lens, pencils, pen, old newspapers, notebook, and adhesive tape (cut into small pieces and stuck to pick); we will journey to the Baltic No. 2 shaft where we will start collecting specimens.

Leaving the college and travelling west on U. S. 41 we go through Houghton, then on M 26 to the village of South Range, a distance of about 7.1 miles. As we approach the village we turn to the left and follow the streets as indicated on the sketch, in order to reach Baltic No. 2 shaft. We should have no difficulty in finding the place, for the shaft, the last one on the left going south, is visible from the village. At the rock pile we will try to collect the following minerals along with others that may strike our fancy.

1. Chalcocite—a dark lead-gray metallic mineral slightly sectile, (polishes when cut with a knife), appearing in white veins cutting chocolate-colored lava fragments. Chemical composition, Cu_2S, Cuprous sulfide. Copper 79.8%.

2. Bornite—Copper red to brownish, iridescent metallic mineral, occurring with chalcocite. The brilliant peacock-like colors that bornite assumes in tarnishing distinguish it from the dark lead-gray chalcocite. Chemical composition Cu_5FeS_4- copper, iron sulfide. Copper 63.3%.

At times along with chalcocite-bornite a brass-yellow metallic mineral is found. It is soft (only slightly harder then a penny) and makes a greenish-black mark on an unglazed porcelain plate. This is chalcopyrite. Chemical composition,

Courtesy Mich. Coll. Min & Tech.

MINERALOGICAL MUSEUM
Michigan College of Mining and Technology, Houghton, Mich.

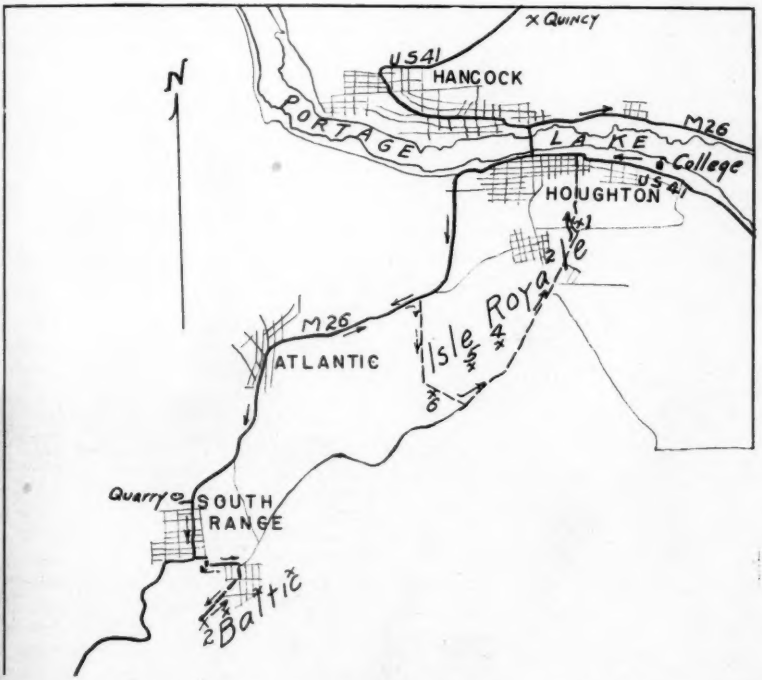
$CuFeS_2$—copper, iron sulfide. Copper 34.5%; iron 30.5%.

3. Ankerite—white cleavable material showing three perfect cleavages at 75°, in veins cutting various colored lava fragments. It usually shows a slight rust on the weathered surface, which readily distinguishes it from similar appearing calcite. Chemical composition variable, $Ca,Mg,Fe,Mn)CO_3$, — calcium, magnesium, iron, manganese carbonate.

Some of the veins in the center contain a pink rhombohedral cleavable material. This may be rhodochrosite,—manganese carbonate, but is more apt to be a pink-colored calcite.

4. The prize specimens are the ones showing white, somewhat rusty veins transversing dark brown-colored lava. In the vein, next to the walls are ankerite and quartz, while in the center is chalcocite, in which there are patches of native copper.

Having labeled the specimens and carefully wrapped them in old newspapers, we retrace our way towards Houghton, but only a half mile from South Range we see a transformer station and an old rock quarry. This location does not contain minerals in abundances, but is an ideal place to observe a typical section of a Keweenawan



lava flow. At the foot of the cut is one of the so-called "felsitic" conglomerates. Those interested in geology can study its pebbles and texture and the effects produced by the lava flows. The conglomerate is overlain by two small flows followed by a larger one, which is well exposed in the cut. The lower part of the fourth flow can be seen toward the end of the cut. At this point we will stop to review the history of a lava flow.

As a lava pours out, it congeals; the top cools faster than the remaining portion and forms a crust, within which are trapped the escaping gases, forming cavities which are called vesicles. Later, when the vesicles are filled with foreign material, such as copper, calcite, agate, quartz, and zeolites, they are called amygdules, and the rock is referred to as an amygdaloidal lava. Most of the cavities are at the top, but there are a few at the bottom.

As the lava advances over the surrounding territory it cools and forms a crust; later movements may break this crust, while the rest of the flow is still liquefied, and the fragments become engulfed in the lava to form what is known as a flow breccia.

The solid material near the surface of the flow chills quickly and is very fine-grained, if not glassy; while that further from the surface is coarser, as it is protected from rapid cooling and has a longer time to crystallize. Flows usually show their coarsest texture about two-thirds of the distance from the top to the bottom.

The solid portion of a flow is called trap, and the porous parts are called amygdaloids; yet they are portions of the same structural unit—a lava flow.

At this old rock quarry the gas cavities (vesicles) are alined in a parallel manner —such structures are said to be cellular, tending toward coalescence. Here at the quarry all the vesicles are filled with thomsonite and a hard dense epidotized material.

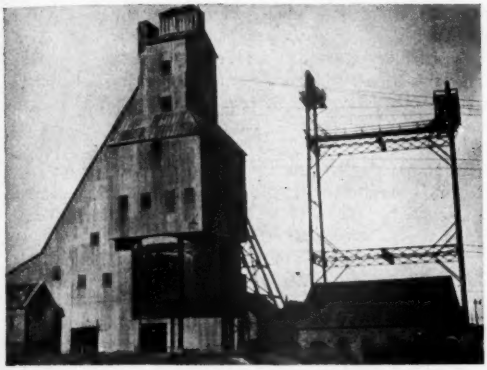
5. Specimens should be large enough (4 by 6 in.) to show the cellular structure and the occasional elliptical amygdules whose lower parts are filled with a crescent-shaped deposit of greenish epidotized material and upper parts with pink thomsonite. This phenomenon is used to determine the top of a flow in places where the flows have been disturbed and now are only partly exposed.

On the way back to Houghton, after going through the village of Atlantic and travelling a distance of 1.5 miles beyond it we make a sharp turn to the right and travel on a gravel road 0.8 miles to a rock pile adjacent to the No.6 shaft of the Isle Royale Mine. To the Northeast the Isle Royale No. 4 and No. 5 shafts and rock piles can be seen. They are located along the strike of the formation; the dip can be ascertained from the slope of the west sides of the shaft buildings. Many minerals can be gathered at these rock piles. Among these are:

6. Prehnite—a greenish (light-apple to oil-green) radiating mineral in veins cutting lava fragments. It is nearly as hard as quartz and closely resembles it. In geodes it builds up into reniform aggregates or circular blocks having rectangular tops. Both the crystalline and the massive varieties should be obtained. Chemical Composition, $H_2Ca_2Al_2Si_3O_{12}$'—a complex silicate of calcium and aluminum. Prehnite is sometimes classed with the zeolites, with which it is often associated. The small gray specks appearing in the prehnite should be carefully scraped with a knife blade. They are likely to be either silver or native copper.

7. Calcite appears in many hues, white, red, pink, green, etc., but the white variety predominates. Calcite shows three cleavages of 75°, and most of the cleavage fragments have striations parallel to the long diagonal of the diamond faces. Various-shaped calcite crystals are to be found in cavities. Chemical composition, $CaCO_3$,—calcium carbonate.

Transparent, highly modified, scalenohedral crystals of calcite with copper and silver inclusions are found in the mines. These crystals under diffused light are very beautiful. Only old collections and jewelry stores have them; they are rarely found in a rock pile. The Quincy and



QUINCY NO. 2 SHAFT
The deepest copper mine in the United States

Courtesy Mich. Coll. Min & Tech.

Central mines were the largest sources of this material.

8. Quartz—both crystalline and massive varieties. Nearly always the prism faces of the quartz have horizontal striations. Quartz is harder than a knife blade and easily scratches glass. Chemical composition, SiO_2,—silicon dioxide.

9. Epidote—various shades of green, tabular crystals occurring in amygdules. Its hardness is that of quartz. Much of the pistachie — (yellowish-green) colored massive material found throughout the district is due to alteration and partial replacement of the country rock by epidote. This process is called epidotization, and the term is used as an adjective, e.g. epidotized sandstone. Chemical composition variable, $HCa_2(AlFe)\ 3Si_3O_{12}$—a hydrous calcium aluminum silicate containing some iron. The massive variety predominates at the Isle Royale mine. Crystals can be collected at the Wolverine Mine.

10. Chlorite—a soft dark-green mineral which occurs as fillings in amygdules, crevices and seams. It has a white streak which is easily obtained by rubbing any sharp object over the specimen. Its chemical composition is variable, but usually chlorite is considered to be an aluminum silicate, with ferrous iron, magnesium, and chemically combined water.

11. Sheet Copper — native copper that occurs in thin sheets.

12. Anhydrite—lilac-colored mineral having three different cleavages at right angles, an arrangement which gives it a brick-like pattern. Its hardness is about that of a penny. It occurs mixed with variously colored calcite. However, the pattern of the calcite cleavages is diamond-shaped. Chemical composition, $CaSO_4$, calcium sulphate.

13. Gypsum—white and soft, showing one perfect cleavage. It can be pried into sheets with the finger nail. It appears in cavities only, and consequently one must break open the rocks to find it. Chemical composition, $CaCO_4.H_2O$,—a hydrous calcium sulphate. Lake Mine and other mines in Ontonagon County have produced the selenite variety. This beautiful transparent mineral often has native copper inclusions.

14. Barite—small, white, tabular crystal associated with calcite and quartz in cavities. By its crystal form it can be readily distinguished from the associated minerals. Chemical composition $BaSO_4$—barium sulphate.

The next stop is the Isle Royale No. 2 shaft. The No. 3 shaft has been demolished, but its dump is visible from the road. The material here is the same as that which occurs at the other shafts, but the location is an excellent one from which to observe various phases of the fragmental lava tops.

15. Breccia — fragmental material. Specimens should be large enough (8 by

6 in.) so that the various types of amygdaloidal lava will be represented. The well-developed slicken-sides should also be included. Often as many as four samp.es are necessary to show the various phenomena.

To the northeast is the Isle Royale No. 1 rock pile visible from No. 2 shaft; it is the next stop. After crossing the tracks we turn to the left and stop just beyond the boarded-up shaft. The shaft is caving in and therefore the boarded portion should be avoided. A short distance from the shaft is a triangulation station (a yellow steel tripod), where there is a splendid example of a glaciated outcrop. The east side is well polished and grooved, while the west side is jagged because of plucking, a condition indicating that here the glacier came from the east. The panorama of the villages of Hancock and Houghton seen from here is very striking.

Standing in line with the last two shafts, No. 1 and No. 2, one is near the contact between the amygdaloid and the flow above it. Once this contact is found, chips should be obtained from the solid rock every ten feet at right angles to the formation or to the north-west. From studying many flows Dr. A. C. Lane came to the conclusion that for every ten feet in distance toward the interior from the bottom of the lava the grains become one millimeter larger. Since in a flow the coarsest crystals are found about one-third of its thickness from the bottom, the ten-millimeter cleavage flash we obtain in sample No. 17 proves that the flow is about 300 feet thick. Hold specimen in the hand and slowlv rotate it, watching for a reflection of light. This reflection is due to the cleavage of the mineral, and hence by it the grain size of the mineral can be ascertained.

16. Ophitic diabase—a very dense, black rock obtained near the contact. Under a hand lens, needle-like grains of calcic feldspar with black, pitchy augite of about the same size can be discerned.

17. Ophite—taken about 100 feet to the northwest of the previous sample. Hand-lens examination reveals augite grains about 10 millimeters in diameter, in wh.ch grayish needle-like calcic feldspars can be seen. The black metallic grains are magnetite, and the soft material is serpentine, an alteration product of olivine.

18. Iddingsite—most abundant at the south edge of the triangulation tower where red flashes can be seen in the rock. This is not copper, although it looks very much like it. It is an alteration product of olivine. Chemical composition, $MgFe_2Si_2O_{10}.4H_2O$—a magnesium, iron silicate with water.

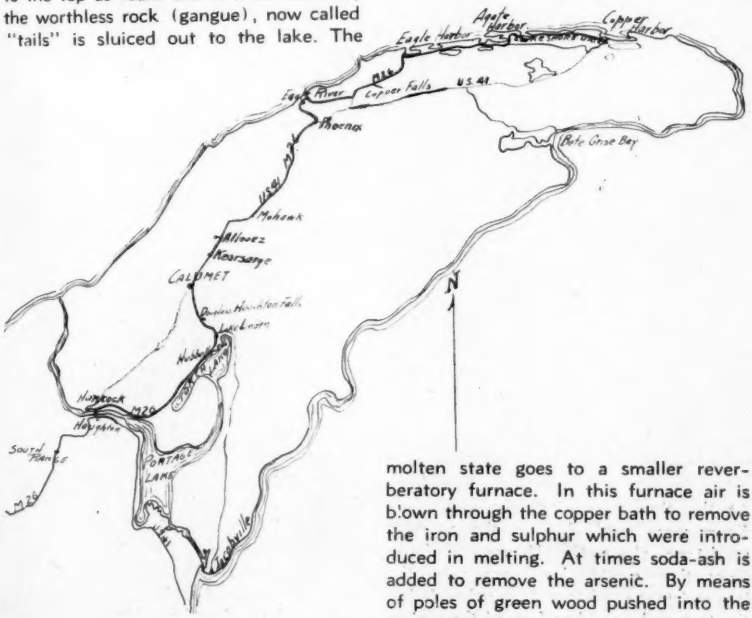
19. Thomsonite—not very abundant, but worthwhile looking for. It occurs as a radiating pink mineral on the surface along joint planes. It reminds one somewhat of the roses usually painted on China. This is the same mineral found in some of the amygdules in specimen No. 5, but here it appears in a different form. Chemical composition variable, $(Ca, Na_2)Al_2Si_2O_8.2\frac{1}{2}H_2O$—a calcium sodium, aluminum silicate with water.

After going straight down the hill to the main street of Houghton, we turn to the left and over the bridge to follow M-26 towards Lake Linden. At the bridge we set the speedometer to zero. Five miles from the bridge corner is a sandstone cut. Many sedimentary phenomena can be observed here—cross-lamination, ripple marks, and concretions. Wonderful ripple-marked sandstone specimens showing both the current and the wave action type can be collected at Jacobsville and Bete Gris Bay. Here pumpkinseed-like clay concretions, originally spherical, but now ellipsoidal in shape due to compaction, can be picked out of the sandstone. These are usually white on the exterior with a red center. the white spherical dots in the red sandstone are another phenomenon to be seen. These so-called "negative concretions" are believed to be due to grains of epidote, graphitic material, etc., which were indirectly responsible for bleaching the red oxide of iron which cements the quartz grains of the sandstone.

From here on along the road is a group of mills in which the copper rock is treated; the metallic copper is sepa-

rated from the worthless adhering trap rock. Worthy of notice is the fact that only 20 pounds of copper may be obtained from a ton of rock treated. The mills are open to visitors, who may apply at the office for a guide. The operation in nearly all the mills is about the same. First the rock is crushed to 5/8 in.-3/16 in. sizes in steam stamps where water is also added. This is the only region where steam stamps are used to crush rock. The mixture of rock and water is screened, and the oversize material goes to intermediate reducing rolls where the product is crushed finer than 3/16 in.; it is then fed to gravity-concentration machines. These are jigs and shaking tables which remove some of the copper. The remaining material goes to ball mills, where it is pulverized to the fineness of four or finer. Then the pulp goes to an agitation tank where it is mixed with pine oil, xanthate, and other compounds. Next it goes to the flotation machines, where the metallic copper which is now adhering to the oils rises to the top as foam and is then removed; the worthless rock (gangue), now called "tails" is sluiced out to the lake. The gray or red piles of sand that are seen along the lake front are the products of these mills. At the present time about 90 to 96% of the original copper content is recovered in the milling process; the amount recovered was not so large in the olden days when methods were less efficient. Today it has even been found profitable to rework some of the old sands. They are reclaimed by means of suction dredges, and after fine grinding are treated by flotation and leaching. Leaching is done by means of cupric ammonium carbonate solution, the copper being dissolved as cuprous ammonium carbonate. This is distilled and yields a copper oxide that goes to the smelter. The ammonia is recovered as ammonium carbonate and is reused in subsequent cycles.

The so-called smelters are really only melting works. In large furnaces, called reverbatory furnaces, concentrates and mass copper are melted up; the gangue, being lighter, goes to the top and is drawn out as slag, while the copper in a molten state goes to a smaller reverberatory furnace. In this furnace air is blown through the copper bath to remove the iron and sulphur which were introduced in melting. At times soda-ash is added to remove the arsenic. By means of poles of green wood pushed into the



Courtesy Mich. Coll. Min & Tech.
DOUGLAS HOUGHTON FALLS

molten copper (poling) the copper is deoxidized; then it is ready to be cast into variously shaped ingots. Silver is present in small amounts. "Half-breeds", or mixed metallic copper and silver, are procurable at jewelry stores.

A review of part of the itinerary on M-26 gives:

Distance	Location
0.0	Bridge, Hancock side
5.0	Sandstone outcrop
6.8	Quincy Mill
8.4	Dredge
8.8	Ahmeek Mill
9.8	Calumet and Hecla Smelter
10.7	Calumet and Hecla Mill
13.1	Roadside spring

One tenth of a mile beyond the roadside spring, we come to a place where an old road joins the concrete. Here we stop, go through the fence, and follow the creek till we come to a deep ravine into which the creek drops. This is the Douglass Houghton Falls. Earlier in the paper we said that the lava flows were originally flat, but later were tipped up. At the time of tilting, the older lava flows were pushed over the younger sandstone along the Keweenaw fault. Since then erosion has worn away the less resistant sandstone faster than it has the trap rock, and has formed the waterfalls found in east-flowing streams. The Keweenaw fault runs along the west side of Torch Lake and Traprock valley, and on it creeks form waterfalls, which make the fault a very conspicuous feature for many miles.

We travel on M-26 through Calumet to Kearsarge, but when we reach the general store and post office (speedometer reading, 18.8) we turn to the right and travel 0.6 miles to the Wolverine mine dump, near the foundation of an old shaft house. Here the Kearsarge flow outcrop can be studied. Large phenocrysts of feldspar in ophite can be seen. The amygdaloidal part of this flow has been very productive, and there is a group of mines along its strike. Many minerals can be gathered here.

20. Microcline — a reddish, platy mineral, usually lining cavities, with white calcite filling in the center. At times this feldspar can be found crystallized in vugs, where it closely resembles rhombohedrons. Close observations shows that the angles are different ($mm = 60°$) and that only one of the faces has a perfect cleavage (face c.) Chemical composition, $KAlSi_3O_8$,—potash aluminum, silicate with variable amounts of soda.

Adularia, another member of the Feldspar group, is found at some of the mines. Its crystal pattern is similar to that of microcline. Its color is usually light brown.

21. Epidote—crystals predominate.

22. Porphyrite—a rock having large, tabular, greenish-gray or pinkish phenocrysts of feldspar in a black ground mass, which, on hand-lens examination, proves to be an ophite.

23. Basalt — black, dense, fine-grained, stony-appearing rock.

24. Shot copper—similar in appearance to shot, but otherwise the same as any other copper found elsewhere in the district.

25. Agates—cryptocrystalline quartz having various colored rings. They are cemented to the matrix very tightly, and it is almost impossible to free them. Agates can be gathered on some of the Lake Superior beaches on Keweenaw Point, where they have been worn away

from the matrix by wave action.

We go back on M-26 in a northeasterly direction to Allouez; when the speedometer indicates 21.2 miles we turn to the left, and 0.4 miles from the main road we stop by a small pond at a sharp turn of the road. Here a red rock dump can be seen, at the end of which, near the abandoned shafts, many different rocks and minerals can be found. This is a conglomeratic dump, and the fragments consist of well-cemented, water-worn pebbles of various sizes. Here those interested can collect pebbles, representing at least six different types of rocks—quartz porphyry to anorthosites. Yet all have one common characteristic—a red hue, due to the abundance of pink feldspar and primary hematite. It should be observed that the ferro magnesian minerals are insignificant in amount. The boulders and the sand filling appear fresh and show very little weathering.

The minerals to obtain here, in addition to copper, are of a secondary nature, formed by the surface waters as they percolated through the rock and oxidized the native copper. Glaciation was responsible for the absence of large quantities of secondary minerals in the copper veins. The glaciers removed all the weathered portions of the veins, and an unknown amount of the unweathered part. Native copper (float) is found in glacial moraines as far south as Illinois.

26. Conglomeratic copper—as a filling among the pebbles, holding them together. Occasionally it has partly replaced the pebbles. A sample should be large enough to include different types of rock pebbles cemented by copper.

Various fantastic shapes are collected by the miners. The variety most prized is a bowl-like specimen, formed by the copper solution replacing the outer surface of a boulder but leaving the center intact; later the rock was broken and removed and the opper was left in the shape of a bowl.

27. Cuprite—a soft, brilliant red mineral with a red streak. Most of it is massive, but occasionally cube crystals with truncated corners (cubes modified by octahedrons) are found in cavities.

Courtesy Mich. Coll. Min & Tech.

Lake Superior Shores along which agates, thomsonites and chlorastrolites can be gathered.

Chemical composition, Cu_2O—cuprous oxide.

28. Tenorite—a dull black earthly mineral with a black streak. Chemical composition, CuO—cupric oxide.

29. Chrysocolla—greenish, or bluish, stony-appearing mineral, which adheres to the tongue. Chemical composition variable; $CuSiO_3.2H_2O$,—a copper silicate with water.

30. The most valued specimen is one showing native copper surrounded by cuprite, tenorite (with chrysocolla further removed), and occasionally a radiating green, silky malachite—a copper carbonate.

31. Calcite—a black-colored calcite occurring as a filling among the boulders.

Just where to go from here is hard to decide, as we are after the rather rare copper-arsenic minerals; the Mohawk, Seneca, and Ahmeek No. 2 shaft are three places where such specimens are most abundant. The copper and the arsenic form a complex mixture, and it is

difficult to distinguish the various minerals. The writer refers to all varieties as the domeykite group, feeling that the use of a reflecting microscope, chemical analysis, and x-ray study are the only sure means of separating the various types. All tarnish to a chocolate brown color, but the tarnish is not always of the same intensity. Three minerals which may be roughly identified by physical tests and hand-lens are here listed:

32. Domeykite—white (silvery) on fresh fracture, metallic mineral, decidedly brittle. Chemical composition, Cu_3As —copper arsenide.

33. Algodonite — pinkish. Chemical composition Cu_6As—copper arsenide.

34. Whitneyite—almost copper red. It is malleable but breaks with hackly fracture, and thus differs from native copper. Chemical composition Cu_9As—copper arsenide.

The next stop is Phoenix. The mines along the ridge on which Phoenix is located were the first to be developed. Their history is fascinating, and some of the stories resemble the Paul Bunyan narratives. These are fissure mines, and here native copper should be collected, although it will not be different from native copper found elsewhere.

35. Apophyllite — brilliant - white, transparent crystals with square faces that have a pearly luster (perfect plus cleavage.) Gray, acutely pyramidal crystals are also found here in cavities of ash-colored lava fragments. Chemical composition, $KFCa_4(Si_2O_5)_4.8H_2O$— potassium fluorine calcium silicate with water.

36. Prehnite—crystalline variety abundant.

37. Ophite—diameter of augite about 1 ½ in.

From Phoenix we take M-26 towards Eagle River. After travelling 1.1 miles, we stop at the edge of the clearing (hay field) on the left and walk to the creek bed on the right. Here the lava flows are different in appearance. The red feldspar is of about the same size and abundance as the greenish ferro magnesian mineral (augite.) This rock is closely related to a diorite, and shows a more acid phase of the lava flows. The flows are cut by a dark, dense rock—a basaltic dike. Specimens can be procured to show the dike and the diorite.

Three-tenths of a mile farther on, just past the rock pile of the Ashbed Mine, is a cut on the left side of the road. The cut shows a lava flow top containing an accumulation of explosive material—volcanic ash—and also some sedimentary material. Most of the amygdules are of chlorite and calcite. The specimen collected should be large enough to show the structure.

We now leave the road and walk at right angles to it, in an easterly direction. We are on the amygdaloidal top of the flow, and on our right we see the trap outcrops of the same flow. About 400 feet farther we cross a small swampy depression, and directly in front of us we see the solid trap which a few feet before was to the right. This change in the type of rock is due to faulting, of a type that is easily recognized. We walk to the river, and at the sharp bend we come upon a scene of considerable beauty. The bank is made of basaltic columns on which cedar trees grow and overhang.

0.9 miles west of the Ashbed mine is the Dr. Douglass Houghton monument, and 1.1 miles farther is the bridge over the Eagle River. The resistant lava gives rise here to a cascade in the river. The dip of the less resistant conglomerate, the so-called Outer Conglomerate, can be seen from this point to the lake.

We now take Keweenaw County road 584; then we go to the left on M-26 for a distance of 5.5 miles toward Eagle Harbor. At Copper Falls we turn to the right and drive on a private road for 0.3 miles to the fork on the road. We leave our car and walk on the upper road, cross Owl Creek, and follow the path till we see a rock pile, where many minerals can be found.

38. Analcite—reddish crystals having diamond-shaped faces, but with no two sides parallel. These crystals occur as cavity-fillings in greenish lava. The white glassy-appearing variety is also found along with the red. Analcite re-

sembles garnet in form, but with a hardness of 5½ it is much softer than garnet. Chemical composition, $Na\ Al\ Si_2O_6.H_2O$—soda, aluminum silicate with water. In the Copper Country analcite alters rapidly into clay as a result of weathering. For that reason if one wishes to obtain good specimens he must break the lava fragments and examine only the freshly-broken amygdules.

39. Small, dull-white, six-sided crystals with flat tops are sometimes found. They are very soft and delicate and will adhere to the tongue. When wet they are plastic and can be worked into a ball. They are believed to be members of the kaolin group of minerals. Chemical composition $H_4Al_2Si_2O_4$—hydrous aluminum silicate.

40. Natrolite—long, slender reddish, four-sided crystals (square in cross-section) with pyramidal terminations, found with the red-colored analcite in cavities. Chemical composition, $Na_2Al_2Si_3O_{10}.2H_2O$—a sodium aluminum silicate with water.

41. Datolite—grayish-white to green, quite hard crystals with very complex crystal form. The lack of symmetry distinguishes this mineral from similar-colored analcite, and prehnite.

Most of the datolite occurs as botryoidal material, which on breaking appears porcelanic. The white variety predominates, but occasionally delicate tints of pink and yellow copper and silver inclusions are found. Datolite has a conchoidal fracture, and is quite hard (5½). It takes a beautiful polish; consequently, cut and polished, it is found in jewelry stores. Chemical composition. $HCaBSiO_5$-, a hydrous calcium boron silicate.

The next stop is Eagle Harbor. Just to the east of the Lake Breeze Hotel are lava flows which act as breakwaters for the harbor. These are the youngest flows of the Keweenaw series. Beautiful specimens of pipe amygdules can here be collected. Some are filled with chlorite, calcite, etc.; others are devoid of minerals and resemble worm holes. Here also the ropy structure of a lava top can be observed; it has the appearance of a pile of twisted ropes. This is due to movements of the liquid lava which raised small folds or wrinkles in the viscous crust. The phenomenon can also be observed at the slag piles of the copper smelters. Samples showing ropy flow should be obtained from both places for comparison. Those interested in artificial minerals can collect from slag cavitics square crystals of Melilite. Chemical composition $Na_2(CaMg)_{11}(AlFe)_4Si_9O_{38}$' a sodium calcium magnesium aluminum iron silicate.

42. Laumontite — radiated salmon pink mineral which crumbles when handled. It breaks into small rectangular blocks, showing two perfect cleavages at right angles. Chemical composition, $(Ca,Na_2)\ Al_2Si_4O_{12}4H_2O$,—calcium sodium aluminum silicate containing water.

From here we take the Lake Shore drive to Copper Harbor and Fort Wilkins. All along the shore agates can be collected. It is unfortunate that they are not large or very showy. The concentrically-banded variety predominates; the moss type is extremely rare. Occasionally greenstones, technically named chlorastrolite, are found. The shore of Isle Royale (the island) is the only place where specimens worth polishing are found.

On the return route we follow the Mountain Drive in order to enjoy the striking scenery.

Courtesy Mich. Coll. Min & Tech.

BROCKWAY MOUNTAIN DRIVE Keweenau, Michigan

6th NATIONAL OUTING
OF THE
ROCKS AND MINERALS ASSOCIATION

Sunday, May 22, 1938

Each year for the past five years the Rocks and Minerals Association has held a national outing the purpose of which is to stimulate the interest in mineral collecting. It is also the period when many amateurs are introduced to their first visit to a mineral locality. Aside from collecting minerals and examining rock formations, the outing also gives one the opportunity of greeting old friends and in making new ones, in having his unknown specimens identified and even in exchanging specimens with other collectors. Truly an outing is a very happy event to which thousands look forward each year with much interest and enthusiasm.

As in previous years, the Rocks and Minerals Association extends a cordial invitation to all readers of ROCKS and MINERALS, and to the general public, to participate in its National Outing.

If an outing is to be held near your city, it is suggested that you register at an early date with the director and if an answer to your letter is desired, enclose a self-addressed stamped envelope. If no outing is to be held in your vicinity, then hold one of your own, inviting some of your friends to join you.

If those having cars could accommodate one or more extra passengers, it would be considered a great favor if they would so inform their directors. Collectors should wear stout shoes and rough clothes and each be provided with a mineral hammer, collecting bag, small note book, pencil, magnifying glass, pen knife, and newspapers. Also, bring LUNCH.

NOTE—Please be careful around mines and quarries. Neither the Association nor the directors nor even the owners of property on which outings may be held will be responsible for any accidents incurred by those participating.

Also note that the three California and the Washington outings will be held on different dates.

The states in which outings will be held and their directors are as follows:

CALIFORNIA

(Northern Branch)

NOTE: This will be a three day outing, May 28-30th.

Directors: Wilfred C. Eyles, 2025 Foothill Blvd., Oakland, and I. Harold Soper, 833 Cabrillo St., San Francisco.

Localities: New Idria Mercury Mine and other mines of the vicinity. The route will be via San Jose, Hollister and the party should arrive at New Idria about 2:00 p.m. Camp will here be made and the afternoon devoted to visiting dumps of the largest and richest quicksilver mine in America; good specimens of cinnabar will be obtained.

Next day, Sunday, other mines will be visited and such minerals will be collected as magnesite, melanite, topazolite, demantoid garnet, uvarovite associated with kammererite on chromite, etc.

The homeward journey will be made Monday.

It is well to keep in mind to bring blankets, grub and a spare gallon or two of gas. Those having cars who can take an extra passenger or two please notify a director at once—all to share alike on expenses which should not run over $5.00 for the trip. A dozen collectors have already signed up for the trip which will be a wow. Are you going! Wow!

Meeting Place: Main Post Office, San Francisco, at 6:30 a.m., Sat., May 28th.

CALIFORNIA

(Los Angeles Branch)

Note: This is a two day trip, May 29 and 30th.

The Los Angeles Mineralogical Society will hold a two day field trip, May 29 and 30., in connection with the annual National Outing of the Rocks and Minerals Association. The Society will meet at Bishop, California, at 9 A. M., May 29th and will visit mineral deposits in the vicinity.

Members making the trip plan to collect sulfur crystals, beryl crystals, black obsidian with cristobalite inclusions and small fayalite crystals on the cristobalite, ruby silver, linarite, cinnabar as well as representative specimens of geologic interest. The country is very interesting from a geologic as well as mineralogic standpoint as the road to Owens Valley and Bishop leads along the scarp of the Sierra Nevada Mountains and passes at the foot of Mt. Whitney, highest mountain in the United States. Coso Hot springs will be visited and many interesting stories center around this old Indian health resort. The Indians took their hot mud baths at these springs long before the white man came to California and they still come to Coso for treatment. An active fumarole will be visited where the steam is depositing sulfur in crystal form before the collector's eyes. Often twigs and pieces of tumble weed are trapped in the vents and becomes encrusted with sulfur crystals.

Permits have been secured for inspection of active mines and all will have an opportunity to inspect mining methods and study some underground geology. The Owens Valley is a very important mining district and present mining operations include salts evaporated from saline lakes, sillimanite (of Champion Spark plug fame), scheelite, gold, silver, marble, slate, talc and many other minerals. This is considered by many to be the most mineralized section of California.

Many of the members plan to take camping equipment and camp out while others plan to stay at auto camps and hotels. Fine camp grounds and good accommodations are available. Members should include in their kit of tools a small bar, 4 or 6 pound sledge, chisels, short handled shovel, and boxes for safe storage of minerals collected. Lunch and water must be carried as noon stops will be made far from restaurants and running water.

Those wishing to make the trip who are not members of the Los Angeles Mineralogical Society should contact Mr. O U. Bessette, Field Trip Chairman, phone ALbany 0441 or 1739 North Ave. 53, Los Angeles.

CALIFORNIA

(Southern Branch)

NOTE: WILL BE HELD MONDAY, MAY 30th.

Director: E. V. Van Amringe, Pasadena Junior College, Pasadena.

Locality: The old Holcomb Valley Mining District north of Big Bear Lake, San Bernardino Co. A number of mines will be visited and many interesting rocks and minerals collected. The region is one of great scenic beauty and geologic interest.

Meeting Place: The group should assemble on the main highway at the west end of Baldwin Lake near the old Pan Hot Springs at 8:30 a.m., Monday, May 30th.

COLORADO

Director: F. C. Kessler, 1020 Macon Ave., Canon City.

Locality: American Feldspar Co.'s quarry where beryl, mica, garnets, etc. are found.

Meeting Place: At the high school building at 2:00 p.m.

CONNECTICUT

(Bridgeport Branch)

Director: Earle Sullivan, 124 Walnut St., Bridgeport.

Locality: Write director for particulars.

Meeting Place: Write director for particulars.

CONNECTICUT

(Hartford Branch)

Director: George Robinson, 16 Simpson St., Hartford.

Locality: Write director for particulars.

Meeting Place: Write director for particulars.

CONNECTICUT
(New Haven Branch)

Director: Franklin W. Pierce, 23 Main St., West Haven.

Locality: Strickland Quarry, near Portland, where many interesting pegmatite minerals may be found.

Meeting Place: Peabody Museum, New Haven, at 9:00 a.m.

MARYLAND

Directors: C. W. Ostrander and Walter E. Price, Jr., Natural History Society of Maryland, 2103 N. Bolton St., Baltimore.

Localities: Dyer Serpentine Quarry, the Patapsco Copper Mine, the Oregon Iron Mine, Limestone Quarries in the vicinity of Texas, and the Blue Mount Trap Quarry. Minerals expected to be found are: Deweylite (fluorescent), magnesite, picrolite, dolomite, magnetite, malachite, chrysocolla, geothite, phlogopite, brown tourmaline, wernerite, tremolite, titanite, pyrite, brucite, sepiolite, williamsite, aragonite, and many others.

Meeting Place: Northwest corner of North Ave. and Bolton St., at 10:00 a.m.

MASSACHUSETTS
(Boston Branch)

Director: Henry G. Savage, 14 Granite St., Leominster.

Locality: Granite quarry at Fitchburg; a joint meeting with the Western Branch.

Meeting Place: Write director for particulars.

MASSACHUSETTS
(Western Branch)

Director: John E. Kitson, 30 Briggs St., Easthampton.

Assistant Directors: Hugh A. Albee, 237 Walnut Hill St., Orange; and Henry G. Savage, 14 Granite St., Leominster.

Localities: Rollstone Granite Quarry, Fitchburg; later a side trip of six miles will be made to a mineral locality at Townsend.

Meeting Place: At the quarry at 1:00 p.m.

Note: The two Massacusetts groups will convene at the granite quarry in Fitchburg. Prof. W. E. Richmond of Harvard University will address the two groups.

NEVADA

Director: Fred Greulich, 1006 Lander, Reno.

Locality: Steamboat Springs.

Meeting Place: Washoe County Court House, Reno, at 9:00 a.m.

NEW YORK

Director: Peter Zodac, Box 29, Peekskill.

Locality: Andover, N. J. iron mines. The locality is about 25 miles, slightly northwest of Paterson, N. J., on N. J. Route 31. About 50 minerals have been found at the old mines.

Meeting Place: At the mines about 11 a.m. With the Andover Hotel in the village as a base (right of Route 31), go north 0.6 miles and turn right. Go 0.8 mile on this road (R. R. to left) until a dirt road leads off to right—a sign "Lake Lenape" is here. The mines begin at this sign—a few feet to right— and parallel the main road for about 1000 feet.

OHIO

Director: George C. Whitaker, 825 E. Schaaf Rd., Cleveland.

Locality: Under the guidance of Prof. Bates of Western Reserve University, the group will spend the day visiting a number of rock and shale outcroppings around Cleveland and Prof. Bates will explain the various formations from a geological standpoint.

Meeting Place: The caravan will start from the Geology Building of Western Reserve University, Cleveland, at 9:00 a.m. Anyone interested is invited to attend. Transportation can be arranged for those not having cars.

RHODE ISLAND

Director: Alonzo Quinn, Dept. of Geology, Brown University, Providence.

Locality: Cumberland, R. I.

Meeting Place: Rhode Island Hall on George St., Providence, at 9:30 a.m.

UTAH

Director: Junius J. Hayes, 1148 East, 1st South, Salt Lake City.

Locality: To be announced at meeting place.

Meeting Place: L. D. S. Business College corner, Main St. and North Temple, Salt Lake City, at 8:30 a.m.

WASHINGTON

Director: Ray C. Gruhlke, 207 Capitol

Theater Bldg., Olympia.

Locality: Through the Cascade Mountains on Blewett Pass.

Meeting Place: Write director for particulars.

Note: This will be a joint trip of the Washington Agate & Mineral Club, of which Mr. Gruhlke is the Secretary, and the Gem Collectors Club of Seattle. The trip will last two days, May 21st and 22nd and plans are to spend the night at a coal mining town of Cle Elum.

We are gratified by the large number of clubs cooperating in the outing. The Northern California Mineral Society, The Los Angeles Mineralogical Society, Mineralogical Society of Southern California, Canon City Geology Club, Bridgeport Mineral Club, The Mineralogical Club of Hartford, New Haven Mineral Club, Natural History Society of Maryland, Reno Rocks and Minerals Study Club, Boston Mineral Club, Cleveland Mineralogical Society, Washington Agate and Mineral Society, and the Gem Collectors Club of Seattle have all registered their cooperation. It may be possible that by the time the outing actually takes place a number of other clubs will also fall in line.

Again we urge all members and readers who are planning to attend an outing that they register with their directors. This would not only give directors an idea how many will attend their respective outings but if plans should be modified those registering would be so advised.

If rain should prevent an outing from being held, the outing may be postponed to the 29th or 30th.

After the outings are over, we would appreciate brief resumes from directors on the activities advising us of the number of collectors who attended and brief descriptions of important finds made.

PETER ZODAC

Acting National Director of Outings.

April 15, 1938.

ANCIENT MINE SAVED GREEK CIVILIZATION

A large specimen of ore from a mine whose yield of silver, about 500 years before the Christian era, changed the entire course of civilization by preventing a world-wide Asiatic supremacy which might have lasted to the present day, is on exhibition in the department of geology at Field Musuem of Natural History, Chicago.

The ore is from the mines of Laurium (Plaka), Greece. From these mines the great Athenian general and statesman, Themistocles, obtained the silver that paid for the building and equipping of a great Greek fleet which decisively triumphed over the Persians under Xerxes in the epochal battle of Salamis, states Henry W. Nichols, chief curator of geology. Without this fleet, many historians are agreed, the Persians would have been victorious, and the Greek civilization which was the father of European culture would have fallen. Asia would probably have dominated the world, and its grip might have remained unshaken until our own times.

In these days, when the cost of a great war, or the mere building of a navy as a measure of preparedness, runs into hundreds of millions, or billions, of dollars, it is interesting to note how little, comparatively, it cost to stem a tide of aggression in Themistocles' day. Records show that the amount of state revenues yielded by the Laurium mines for the fleet was only 100 talents, or a sum in the ancient Greek coinage equivalent to about $144,600 today. Yet, in the opinion of many authorities, comments Mr. Nichols, this fleet was of more importance in world history than the fleet of the great naval pwers today, and its victory had a more profound effect on the course of past and modern events than the result of the world war of 1914-18.

Gem Minerals Of The Region About Orofino, Idaho

By BOYD OLSON,
Vice-Pres. Orofino Mineral Society

(A Contribution from the National Geological Club)

Orofino, a city with a population of about 1,500 and County seat of Clearwater County, is located along the Clearwater River in North Central Idaho. Clearwater, Lewis and Nez Perce Counties meet together but a few miles northwest of Orofino. This region is served by some excellent highways, namely the famous North and South Highway and the Lewis and Clark Highway, and offers a new field for mineral collectors. It has hardly been explored as far as the gem minerals are concerned and many new finds will undoubtedly be made as collecting progresses in this area. Some of the gem minerals have been described from this area but for the most part the ones mentioned here are new finds being described for the first time.

Corundum (Sapphire)

Clearwater County. Sapphires have been found along Rhodes and Orofino Creeks near Pierce City. The sapphires are found as small water worn pebbles in a variety of colors from deep blue through pale blue to greenish. But little of it is of gem quality.

Tourmaline

Clearwater County. Black tourmaline has been found along Orofino Creek near Orofino and further east in the western section of the Clearwater National Forest. No colored tourmaline is known from this area.

Quartz (Rock Crystal)

Clearwater County. This variety has been found in the massive and crystal form about two miles west of Orofino. It is of a good quality. Some large crystals have been found at times at this locality.

Quartz (Malachite stained)

Clearwater County. Some very pretty Malachite stained quartz has been found at Orofino. A ledge of it outcrops right in the city. The light green colors of the quartz make attractive cabochons when cut and polished.

Agate

Clearwater County. This variety of quartz is rather rare in the region as only a few agates have been found. Some moss agate has been found in the basalt on a road cut above Ahsahka, northwest of Orofino. An excellent polkadot agate was found along the Clearwater River about six miles up from Orofino.

Jasper

Clearwater County. Some good red and yellow jasper has been found near Cavendish and on Cedar Creek just east of Southwick. Jasper has also been found along the Clearwater River at Orofino.

Nez Perce County. Jasper in different colors has been found on Mission Creek above Lapwai.

Chalcedony (white)

Clearwater County. This variety has been found at a number of localities, chiefly in the basalts around Orofino.

Garnets

Clearwater County. Garnets are quite plentiful in this region. Most of the stream beds in this area contain garnets more or less. Some of the localities are on Orofino Creek four miles up from Orofino and on the North Fork of the Clearwater River at various places. Fifteen miles up the North Fork River, garnets are quite plentiful. They occur in the schist-gneiss rocks of this region. Garnets are also found on Cow Creek a tributary of Orofino Creek. The garnets are of a reddish-purplish color and are of the Almandite-Spessartite variety. Grossularite garnets have also been found in this County. Some of the garnets from this area are of gem quality.

Nez Perce County. Gem quality Almandite garnets have been reported to occur in placers near Lewiston.

Epidote

Clearwater County. This mineral is present at a number of localities in the County. It has been found in the concentrates from placer gravels near Pierce

City. Some crystallized Epidote occurs about two miles west of Orofino. Some large crystals were found along the Lewis and Clark Highway below Orofino.

Zircon

Clearwater County. Small transparent Zircon crystals have been found on Rhodes Creek near Pierce City and along Musselshell Creek.

Opal and Opalized Wood

Clearwater County. This mineral is quite plentiful in this and adjoining counties where the huge flows of basalt lie. The opal occurs in various colors and is of gem quality. Some good red colored opal is to be found in road cuts above Ahsahka. Good opalized wood is also present in the vicinity. Green colored opals have been found near the top of the Ahsahka-Cavendish Highway.

Lewis County. Some good white opalized wood has been found near Kamiah.

Nez Perce County. Opals in various colors have been found about four miles west of Cavendish. Opalized logs are quite plentiful here. Good opals, some banded, and opalized wood occur one mile east of Leland. Opals have also been found on Mission Creek above Lapwai.

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AN OCCURRENCE OF GRAPHIC TOURMALINE IN THE HUDSON HIGHLANDS

By S. B. BUTLER

Most collectors are familiar with the graphic texture which is often found in igneous rocks. It is most common in granite where it is the result of an intergrowth of quartz and orthoclase. The quartz is arranged in wedges and prisms which intersect at sixty degree angles which produces the "graphic" effect. Such intergrowth textures are frequently due to the crystallization of a eutectic mixture. There is abundant literature which covers the whole field of theory and description of this subject.

The texture is found in other rocks, besides granite, but less frequently. It is more often of microscopic than macroscopic development.

Naturally it is best studied in polished specimens. The rock to be described below should be of interest to amateur lapidaries because the strong color contrast of the constituents emphasizes their relations.

The graphic tourmaline rock was seen on the west flank of Dunderberg Mountain, west of the Hudson River, in southeastern New York. It consists of intergrown grains of black tourmaline and glassy quartz. The grains size ranges from two to ten millimeters. The highly intricate branching and embayed forms of the tourmaline are well shown against the white groundmass. In common with similiar formations, the crystals all appear to have a like orientation. For this reason the texture is best seen along certain planes. Large rock masses are not to be found. The largest masses seen would weigh only a few pounds.

The source of this rock is an intrusion which has entered the Grenville schists here. The intrusion consists largely of a mottled grey and white feldspar and shows some crystals of black tourmaline. The graphic rock consists of small veinlets a short distance from the intrusion. It is to be noted that the quartz-tourmaline rock contains no feldspar.

The source and development of this rock is probably not any different from other rocks of this composition.

An interesting description of a quartz-tourmaline rock formed at a contact may be read on p. 628, "The Data of Geochemistry", by F. W. Clarke. The subject of tourmalinization is covered in texts on petrology.

FOSSILS AND FOSSIL COLLECTING

By IRVING G. REIMANN,
Curator of Geology, Buffalo Museum of Science

Part III—Fossils Preserving Hard Parts Unaltered

The hard parts of animals consist of their skeletal structures, whether they are external, as in the shellfish, or internal, as in the vetebrates. These more resistant parts, even under unfavorable conditions, outlast the tissues of the muscular, nervous, circulatory, or digestive systems. When buried in a medium favorable for their preservation they may be preserved without decay or replacement for many millions of years.

The skeletal parts of animals are usually composed of chitin (a complex organic substance resistant to acids and alkalies) as in crabs, trilobites, and eurypterids; enamel and dentine, as in certain fish plates and scales and in teeth; calcium phosphate, as in bones; silica, as in some sponges and in radiolaria (a type of one-celled animal); calcite and aragonite, as in corals and many classes of shelled animals. These materials are given in the order of the likelihood of their preservation, chitin being the most easily preserved, and aragonite the most easily dissolved.

Plants are usually composed of cellulose, and silica. Diatoms (one-celled aquatic plants), horsetails, and margins of grass blades are high in silica. Certain aquatic algae deposit thick coatings of calcium carbonate, which in some instances is of major importance in the construction of "coral" reefs. Resin is exuded by certain coniferous trees and, as we have seen, may be preserved as amber.

In many localities, shells of various types are the most common fossils. In the Cenozoic rocks the shells are commonly found unchanged except for the loss of organic matter, and they present a more or less chalky appearance. Even in the Cretaceous rocks such shells are abundant in favored localities.

About ten years ago I spent a day at Coon Creek, near Enville, Tennessee, a Cretaceous locality which has yielded over 400 species of fossils (Bruce Wade, The Fauna of the Ripley Formation on Coon Creek, Tenn., U. S. Geological Survey Prof. Paper 137, 1926). Here in a small ravine, which started its existence as an insignificant irrigation ditch for Dave Week's cotton patch, are to be seen thousands of white shells protruding from the soft, marly, sandy walls of the ravine. They are so soft that great care must be used in removing them, and it is desirable to harden them artificially before they are handled very much. Some hard concretions at this classic spot contain crabs, shells, bryozoa. Certain shells (Baculites and others) present the most beautiful and intense play of colors conceivable. And yet this deposit is at least seventy-five million years old!

In the older rocks such fossils become increasingly rare, until they become almost absent in the early Paleozoic strata. One exception is Lingula, a little brachiopod (lamp shell) whose shell is composed principally of calcium phosphate which is more stable than calcium carbonate, the usual shell material. The name Lingula means "a little tongue" and is descriptive of the form of this shell.

Fish teeth and enameled scales are common in rocks as old as the Devonian. Many vertebrates are known by their teeth alone, the more destructible parts of their skeleton having disappared. It is really fortunate that teeth are made of such long-enduring stuff, because they are more important than any other single part of a vertebrate's skeleton in giving clues to its former owner's relationship and food habits. Many splendid localities for the collection of fossil shark's teeth (and shells too) exist along the Atlantic coast, some of which, such as the Chesapeake Bay localities, are within an easy day's drive of some of our largest cities.

The bones of vertebrates may be found unaltered in the younger rocks, but in those older than the Cenozoic they become more rare, partly because their porosity invites the infiltration of petrifying agents.

"HOW OLD IS SOL?"

By WM. SULZER

Former Governor of New York

Every person interested in Rocks, and Minerals, should know much about Geology, and something about Astronomy. Our earth, in the Stellar Universe, is a little grain of sand on the limitless shore of infinite space. Yet everything in and on this planet is made of the same stuff as the stars. Every living thing is made of the same elements we find in the most distant nebulae, and the same natural laws guide our activities, and control our destinies.

Astronomy is the story of the stellar universe. It is a sad commentary, on the progress of human intelligence, that so many people know so little about Astronomy.

The ancient Arabs, in Chaldea; the ancient wise men in Egypt; and the ancient philosophers in China, thousands of years ago, without modern mechanical instruments, named the stars; mapped the constellations; and knew almost as much about the great Island Universes, in space, as we do now. The Greeks, in later times, derived their knowledge of the stellar universe from these peoples, and the Greeks classified it for future generations.

However, all the stars, except the star we call the Sun, are so far away from the earth that they have practically no influence on our planet. Some progress, nevertheless, is being made. These giant stars in space are now being studied through powerful telescopes.

From very distant epochs humans have observed the star nearest the earth which we call the Sun. Every ancient people had a different name for this star. The Romans, and the Spanish people, call it "Sol." The French call it "Soleil." The Germanic people called it "Sonne." From this latter word came the Anglo-Saxon word "Sun."

As explained in a previous article, entitled "The Birth of the Earth," our Sun is a female star. She was married. Her husband—a male star—died shortly after the marriage. All the planets, in our solar system, are the children of this marriage. She is more than 93,000,000 miles distant from the earth. Her diameter is 864,375 miles. Her circumference is 2,593,125 miles. She is, comparatively speaking, a small star, belonging to the great island universe we call the "Milky Way," and far out in space from its confines.

However, our Sun is no mean star. She is very much alive, and exceedingly bright. According to my mathematical calculations, she was born about three trillion years ago. She is now in her prime and will live, unless something unforseen happens, for at least three trillion years to come. So long as she lives she will give life, and heat, and light, and power, to the earth. In view of these mathematical calculations no one need be alarmed about the end of the earth.

Stars are born, and live, and die, like all other things. The life of a star is about a thousand trillion years. A trillion years, according to the French system of enumeration, which is followed in the United States, is 1,000,000,000,000 years, which constitute a long period of life for Mrs. Sol if you figure it out mathematically.

Our Sun is "Old Mother Nature." She is the "Creator" of everything in and on the earth. She is the source of all life; of all power; of all heat; of all light; of all motion; and of all matter. Her laws are immutable. If anyone should ask you can say for me she is a mighty hot mama, having a temperature of about 2,000 degrees Centigrade on her surface, and about 6,000 degrees Centigrade in her interior. It is almost impossible for anyone to conceive of such heat; and such power; and such energy. As she grows old she will gradually cool off, but the change is so slow that one must come back a trillion years from now to detect it.

In his great book on the Stars, Mr. Newcomb says: "Each star goes through changes analogous to those of a human being from birth to old age. In its infancy a star is simply a nebulous mass; it gradually condenses into a smaller volume, growing hotter . . . until a stage of maximum temperature is reached, when it begins to cool off."

The Sun does not set or rise. When we hear people speak of sunsets, and sunrises, it simply means they are referring to the rotation of the earth on its axis from West to East. The Sun also revolves on her axis every twenty-six days. She is spherical in shape, and very beautiful. She is our only accurate timepiece. She has other motions, like the earth, which are not necessary to mention here, except to say that she is traveling, in a straight line, at the rate of fourteen miles a second, with all her planets, toward the great star Vega in the constellation of Lyra.

During 1910 when I was traveling in Guatemala I saw a native, sitting on his doorstep, gazing at the Sun. The man interested me.

"What are you looking at, Senor?" I asked.

"Old Sol, Senior," he replied.

"How old is Sol?" I inquired.

"Quien sabe, Senior?" he answered.

During the Middle Ages it was the fashion to belittle our Sun. They said it was an "insignificant" star. Since then we have learned that although it is exceeded in intrinsic brightness, or candle power, by many of the stars, it is much brighter than the great majority of them.

Dr. A. Van Maanen, of the Mount Wilson Observatory, recently remarked that of the 100 stars within a distance of 30 light years, from the earth, only twenty are brighter than our Sun, while more than seventy are five magnitudes fainter, and emit, respectively, less than one hundredth, and one ten-thousandth, as much light as the Sun.

There are no fixed stars. That theory of the ancients has for years been exploded. Everything in the stellar universe is in constant motion, and sometimes at velocities that stagger the finite mind.

Years ago when I went to Congress I made it a rule, when I was not busy attending to my official duties, to go to the various bureaus of the Government, and learn everything I could about them. In pursuit of these endeavors I often went to the Naval Observatory, then in charge of Simon Newcomb. We became friends. He was the greatest astronomer since Isaac Newton. Many scientists say that Simon Newcomb was the greatest man ever born on the Western Hemisphere. Whenever the nights were clear, and I had nothing else to do, I went to the Naval Observatory and watched Mr. Newcomb studying the stellar universe. He interested me in astronomy. He gave me his books to read, and I studied them. No better books on astronomy were ever written. They should be taught in all our schools. I never interrupted Mr. Newcomb when he was at work, but when he had leisure I talked with him, and learned much. He prepared, and issued for our government, the Nautical Almanac, which is the Bible of all the men who sail the Seven Seas. He had an associate named Albert A. Michelson, afterwards connected with the University of Chicago.

One night, when I was present, Mr. Michelson asked Mr. Newcomb if he had estimated the velocity of light. He said he had. Then he got out a small book, and showed us by figures that the speed of light was 186,244 miles a second, which would be about a trillion miles a year. This was one of the greatest discoveries in astronomy. In after years Professor Michelson proved beyond successful contradiction that Mr. Newcomb was right.

On another occasion I asked Mr. Newcomb this question: "If our solar system is traveling towards Vega, at the rate of 14 miles a second, how long will it take us to get there?" "That," said Mr. Newcomb, "depends on how fast Vega is moving away from us." I learned much from Mr. Newcomb regarding the stellar universe. I owe him a debt which can never be paid. The things he told me induced me to study the stars. At his suggestion I was instrumental, as a member

of Congress, in establishing the Astrophysical Laboratory, in Washington, through which agency much accurate information concerning our Sun has been obtained.

The greatest thing that can be seen by mortals on this planet is our Sun, and especially her corona. The corona can be seen with smoked glasses during any eclipse. It is indescribable, and a stellar sight that staggers the imagination. It is the most superb spectacle that we can see in the stellar universe.

Many scientitists have discussed the sun spots, and have speculated about them more or less intelligently. None of these scientists, so far as I am aware, has ascertained the truth about these sun spots. From careful study, and observation, I am convinced these sun spots are magnetic storms that sweep a part of the surface of the Sun. They come to the surface, from the depths, on account of subterranean disturbances. Sometimes they are small, and then become large, but when we see them they are all surface phenomena. They come and go, at regular periods, just like storms on this planet. What effect they have on the earth has not, as yet, been satisfactorily determined.

It is my judgment that we are only on the threshold of knowledge concerning our Sun. I look far in the future. I see the day when her tremendous energies will be utilized by man to give the people of th earth all the heat, light, and power they will ever require, for every comfort; for every purpose; and for every mechanical device now invented, or hereafter to be invented, and constructed, by the imaginative genius of the human brain.

All hail Mother "Sol"! Long may she live to bless the earth—and all living things in this good "Old World" of ours.

Bibliographical Notes

The Gem Minerals of Oregon; By Dr. H. C. Dake. The versatile editor of **The Mineralogist**, has just had issued a very interesting bulletin in response to a wide public demand for information on the gem mineral resources of his State. The bulletin is not intended as a technical description of gem stones of Oregon, but merely as an enumeration of the known occurrences of gem minerals within the State. Issued by the Oregon State Department of Geology and Mineral Resources, 704 Lewis Bldg., Portland, Ore., as Bull. No. 7, 16 pp., 9 illus., price 10c.

Annual Report of the Quebec Bureau of Mines for the Calender Year 1935. Part D, 42 pp., 3 pl., 1 map. **Upper York River Area, Gaspe Peninsula:** By I. W. Jones, pp. 3-28; **Marbleton and Vicinity, Dudswell Township, Wolfe Co.:** By Abbe J. W. Laverdiere, pp. 29-40. Issued by the Quebec Bureau of Mines, Quebec, Canada.

BOOKS

Story of the Gems, H. P. Whitlock	$ 3.65
Getting Acquainted with Minerals, Geo. L. English	2.65
Minerals of N. Y. City, J. G. Manchester	2.65
How to Study Minerals, E. S. Dana	2.15
Hand Book for the Amateur Lapidary, J. H. Howard	2.00
Dana's Text Book, Wm. E. Ford	5.75
Dana's System of Mineralogy	15.50
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Bulletin No. 180. Franklin Minerals is in print again	60c

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THE AMATEUR LAPIDARY

Amateur and professional lapidaries are cordially invited to submit contributions and so make this department of interest to all

Asteriated Rose Quartz

The finest asteriated rose quartz known, at least to collectors in the East, is that occurring in the feldspar quarries at Bedford, N. Y. Here rose quartz occurs in four types and all massive.

One type is a very pale rose color—so pale in fact that it is almost milky. Another type is zoned or banded but of a deeper rose color. The third type and which forms the best mineral specimens is a deep rose but often much fractured. The fourth and rarest is the gem variety from which the asteriated gems are cut. Generally the gem variety occurs in but tiny pieces, is of a pale-smoky rose color, translucent and flawless.

From examination of many specimens, the gem variety is found in the center of large masses of rose quartz which in general are considerably flawed, fractured and appear almost opaque (subtranslucent).

Rough pieces of rose quartz do not show asterism (star-like ray); they must first be cut en cabochon and then polished.

Club and Society Notes

On March 12, 1938, the Mineralogical Society of Hartford, Conn., was organized with 13 charter members. George Robinson was elected President, Charles W. Hoadley, Treasurer, and H. W. Gale, Secretary. The next meeting will be held May 12th, at the Children's Museum, Hartford.

The Club voted to and has become affiliated with the Rocks and Minerals Association.

Ray C. Gruhlke, Secretary of the Washington Agate & Mineral Society, Room 207, Capitol Theater Bldg., Olympia, Wash., very kindly extends a cordial invitation to members of the Rocks and Minerals Association to call on him if they should be in his vicinity. He will be glad to see them and wll outline field trips to localities nearby. His area is very rich for collecting.

David M. Seaman, 6321 Howe St., Pittsburgh, Penn., one of our good friends in the "Smoky City", extends a cordial invitation to all fellow members of the Association to call on him if they are interested in collecting fossils. There are a number of localities near his city where marine invertibrates of Pennsylvanian Age may be found.

Geo. Williams, Reliance, S. D., is another member who extends an invitation to members of the Association to call on him if they should be in his vicinity. He will personally guide any member in good standing to localities of his vicinity which are many. Agates, petrified woods, fossils, arrow heads, etc. are plentiful. Reliance is on U. S. Highway No. 16, 90 miles west of Mitchell, S. D.